

Abnormal Eggs and Incubation Behavior in Northern Bobwhite

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ABSTRACT.—A long-term (>5 years) study of Northern Bobwhite (*Colinus virginianus*) provided the first record of runt eggs and two observations of prolonged incubation. During 2004, we located two clutches ($n = 11$ and 9 eggs)—laid by the same hen—consisting entirely of runt eggs. Mean length, width, and mass were 18.8 mm, 15.4 mm, and 2.0 g, respectively, 26% of the volume and 24% of the mass of typical bobwhite eggs. Based on our long-term data set for bobwhites ($n = 3,566$ eggs), runt eggs occur at a frequency of 0.56%, within the range (0.02–4.32%) reported for other avian species. The two records of prolonged incubation behavior represented 75 days (326%) and 47 days (204%) beyond the normal incubation period (23 days) of bobwhites. This prolonged incubation behavior is in excess of the time frame reported for most birds exhibiting prolonged incubation (50–100% beyond normal incubation). Received 31 January 2005, accepted 3 October 2005.

Documenting anomalies in avian behavior often is an opportunistic endeavor given the rarity of such behavior and the short-term nature (<2 years) of most studies. An ongoing, long-term (>5 years) radiotelemetry project (The South Texas Quail Research Project; STxQRP) on Northern Bobwhite (*Colinus virginianus*) provided us with the opportunity to monitor bobwhite behavior over seven breeding seasons (1998–2004) on the Encino Division of the King Ranch, Inc., Brooks County, Texas. We provide the first record of runt eggs for Northern Bobwhite and two additional records of prolonged incubation behavior.

First record of runt eggs.—Runt eggs, also referred to as dwarf, cock, wind, and witch eggs (Rothstein 1973), are those noticeably smaller than the smallest expected for a given species (Mulvihill 1987; for suggested criteria, see Koenig 1980a). Although runt eggs have been reported for several avian species

(e.g., Canada Goose, *Branta canadensis* [Manning and Carter 1977]; woodpeckers [Picidae, Koenig 1980b]; and Eastern Bluebird, *Sialia sialis* [Mulvihill 1987]), they normally occur at low frequencies (~1 per 1,000 to 2,000 eggs; Koenig 1980b, Mallory et al. 2004). Furthermore, runt eggs usually represent only a small proportion of a clutch (Rothstein 1973, Ricklefs 1975, Bartel 1986). Entire clutches consisting solely of runt eggs are extremely rare and have been reported only for Song Thrush (*Turdus philomelos*; M'William 1927), Gray Catbird (*Dumetella carolinensis*; Rothstein 1973), and Eastern Bluebird (Zeleny 1983). We report the first record of runt eggs for Northern Bobwhite and provide estimates of the frequency of such eggs.

On 21 June 2004, we located a radiomarked hen on a nest at the base of brownseed paspalum (*Paspalum plicatulum*). The clutch consisted entirely of runt eggs ($n = 11$). We monitored the hen for several days thereafter, but never located her at the nest site again. We concluded that she had abandoned the nest and we collected the eggs. During the following 5 weeks, the hen again paired with a male, and on 30 July, we documented a second clutch of runt eggs ($n = 9$) in a nest constructed in red lovegrass (*Eragrostis secundiflora*). The hen also abandoned this nest, and we collected the clutch on 2 August.

None of the runt eggs was viable (i.e., none contained yolk). Mean length, width, and mass of the runt eggs ($n = 20$) were 18.8 mm, 15.4 mm, and 2.0 g, respectively. The smallest reported measurements for bobwhite eggs are 26 mm (length) and 22.5 mm (width) (Bent 1932), and 8.2 g (Case and Robel 1974). Koenig (1980a) defined runt eggs as those with a relative volume ($\text{length} \times \text{width}^2 \times \pi/6$) <75% of the average. Mean length, width, and mass of bobwhite eggs are 30 mm, 24 mm, and 8.3 g, respectively (Bent 1932, Case and Robel 1974). Thus, the volume and mass

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of the runt eggs we found were only 26% and 24%, respectively, of the average.

We used data from STxQRP and Hernández (1999) to estimate the frequency of runt eggs in Northern Bobwhite. During 1999–2004 of the STxQRP, we located 392 nests and determined clutch size for 297 nests ($n = 3,161$ eggs). Hernández (1999) located 83 bobwhite nests in Shackelford County, Texas during 1997–1998 and determined clutch size for 35 nests ($n = 385$ eggs). Based on these combined data (3,546 normal-sized eggs + 20 runt eggs), runt eggs in bobwhites occur at a frequency of 0.56%, which is within the range (0.02–4.32%) reported for other avian species (Koenig 1980b, Mallory et al. 2004).

The mechanisms underlying the production of runt eggs are not entirely understood (Mulvihill 1987). However, runt eggs often are produced after temporary disturbance or damage (e.g., injury or infection) to the reproductive organs (Pearl and Curtis 1916, Romanoff and Romanoff 1949). Instances of entire clutches being composed of runt eggs suggest a congenital defect or permanent injury to the reproductive system (Mulvihill 1987). We presume the bobwhite hen that laid the runt eggs may have suffered from some type of permanent injury to her reproductive organs.

Prolonged incubation behavior.—Prolonged incubation beyond the normal time required for hatching has been reported for many avian species, including Killdeer (*Charadrius vociferus*; Powers 1978), Common Loon (*Gavia immer*; Sutcliffe 1982), and Long-eared Owl (*Asio otus*; Marks 1983). Most birds that exhibit prolonged incubation appear to incubate for at least 50–100% longer than necessary to hatch a clutch (Skutch 1962). Prolonged incubation (56 days) has been reported only once for Northern Bobwhite (Stoddard 1931), which is 33 days (143%) beyond the average incubation period (23 days). We report two additional records of prolonged incubation for Northern Bobwhite.

During our first observation of prolonged incubation, a bobwhite hen exhibited normal incubation behavior during a first nesting, and the eggs successfully hatched on 7 July 2003. However, the hen exhibited prolonged incubation of a second clutch. We discovered the nest on 11 August, and by 8 September, only 1 of 10 eggs had hatched. The female was not

observed on the nest between 9 and 25 September, but on 26 September, the hen returned to the nest and resumed incubation until 5 December. Thus, the hen incubated the eggs for 28 days, abandoned the nest for 17 days, and then resumed incubation for another 70 days. The 98 days of incubation was 75 days (326%) beyond the normal incubation period for bobwhites.

We documented the second occurrence of prolonged incubation during the 2004 nesting season. On 18 June, we accidentally flushed an un-radiomarked hen from a nest. We returned to the nest site on 12 July, presuming the clutch had hatched, and found her still incubating the clutch. The hen continued incubating until 27 August, when the clutch was depredated. Assuming the hen had just begun incubation when we first found the nest, she incubated for at least 70 days, or 47 days (204%) beyond the normal incubation period for bobwhites.

Although only 1 of 10 eggs hatched in our first observation of prolonged incubation, Murray and Frye (1957) suggest that the hatching of even one egg is sufficient to satisfy the nesting instinct. In our observation, however, the hen continued incubation even though only one egg hatched. Hurst (1978) observed a similar phenomenon, during which a bobwhite hen continued incubation of partially hatched, dead chicks. The clutch consisted of 10 eggs: 1 infertile, 1 completely hatched, and 8 partially hatched. The eight partially hatched eggs contained fully developed chicks that had pipped and partially ringed their eggshells but had become “entombed.” Hurst (1978) did not report the length of time that the hen remained on the partially hatched eggs.

Prolonged incubation is thought to provide a safety margin for eggs that take longer than normal to hatch (Skutch 1962, Holcomb 1970). However, Holcomb (1970) suggested that prolonged incubation would be maladaptive for species capable of renesting. Bobwhites commonly renest two or three times per breeding season, regardless of previous nest fate (Stoddard 1931). Given that the two records of prolonged incubation occurred toward the end (July–August) of the normal nesting season for bobwhites (May–August), the opportunity for renesting was limited and

may have contributed to prolonged incubation.

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